

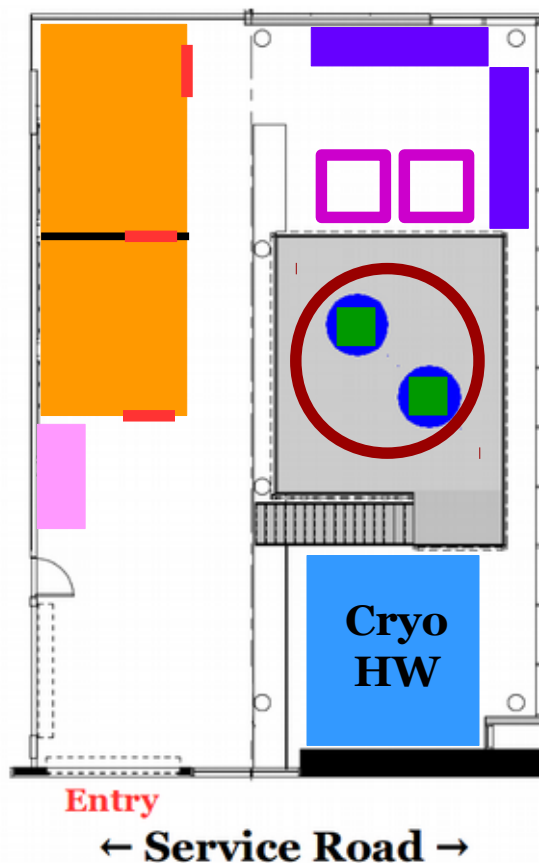
TPC Assembly and Testing Update

Jay Jablonski, Michael Mooney, Zach Rautio
Colorado State University

Andrew Lambert, Tom Rathmann
Lawrence Berkeley National Laboratory

ArgonCube Engineering Meeting
March 26th, 2021

Overhead View @ MATF

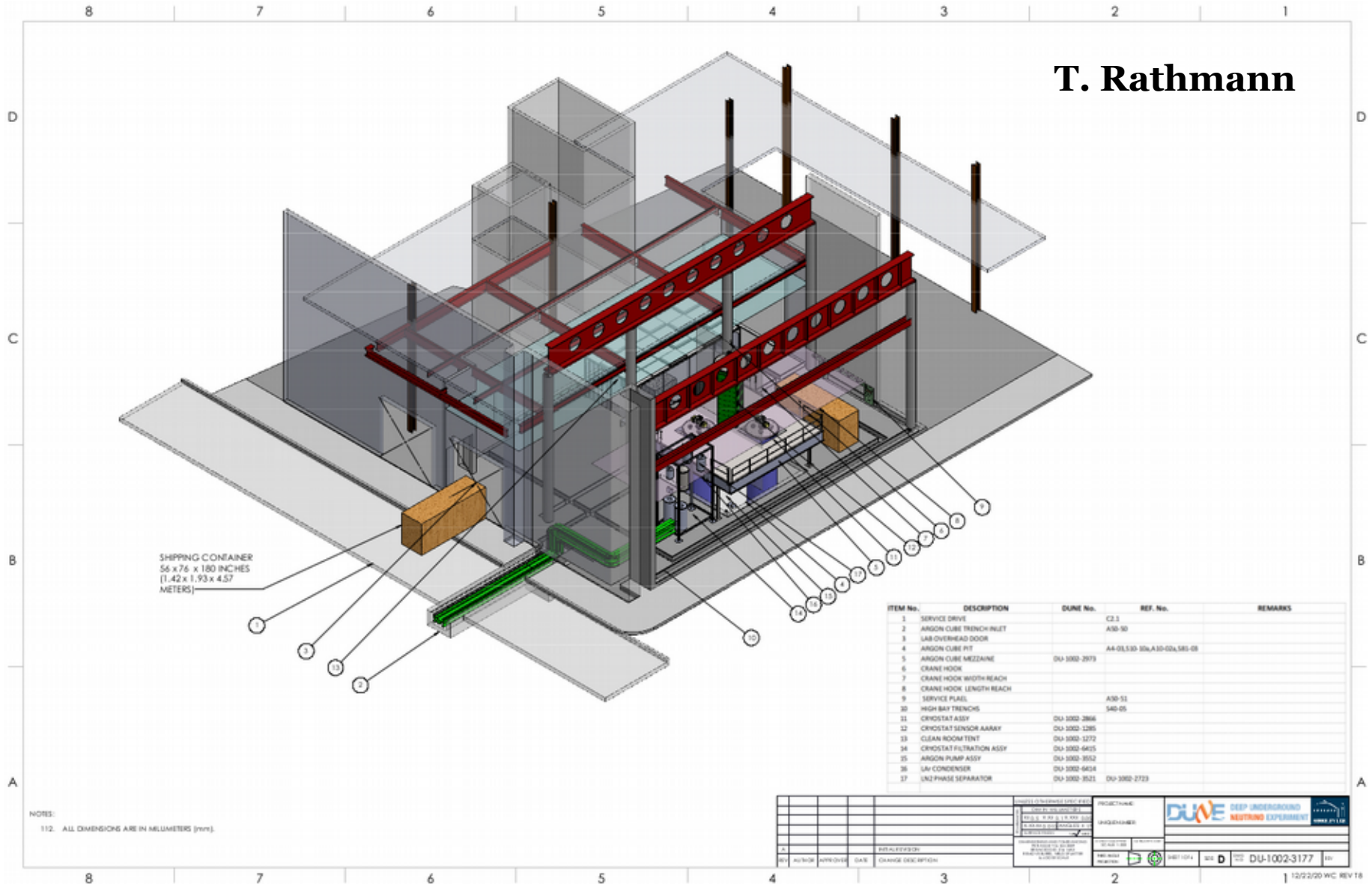


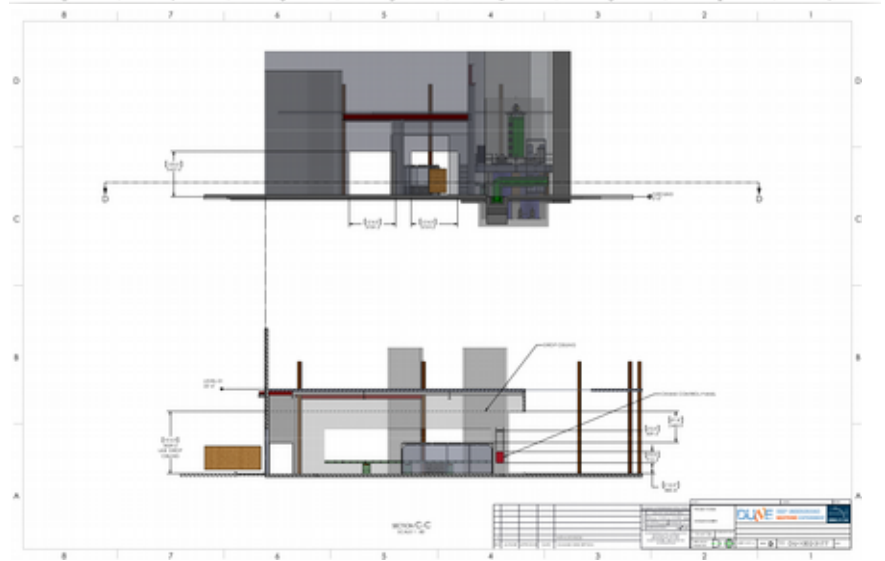
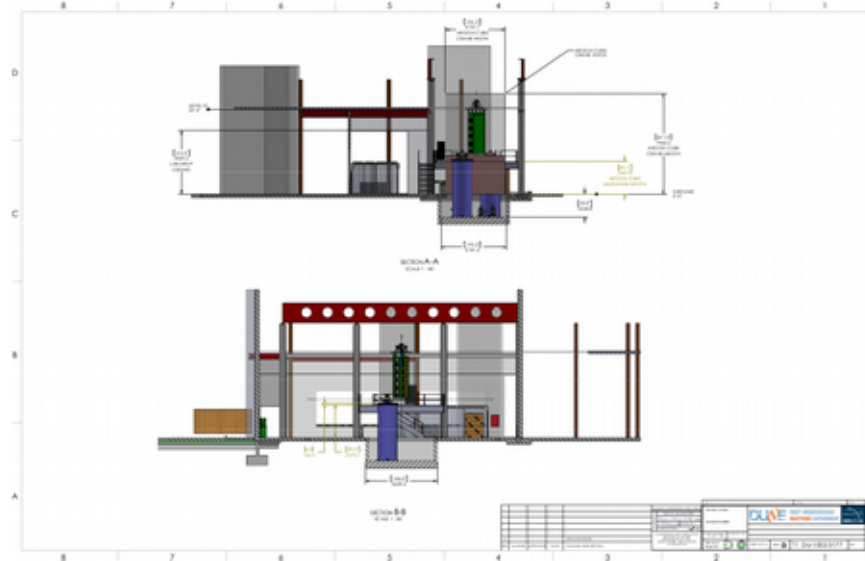
See **DUNE Collaboration Meeting Talk** for More Details on **Operations Workflow** at MIF

- ◆ Brief update today on TPC module assembly and testing
- ◆ Near-term focus is on **MATF activities**

Updated MATF Drawing

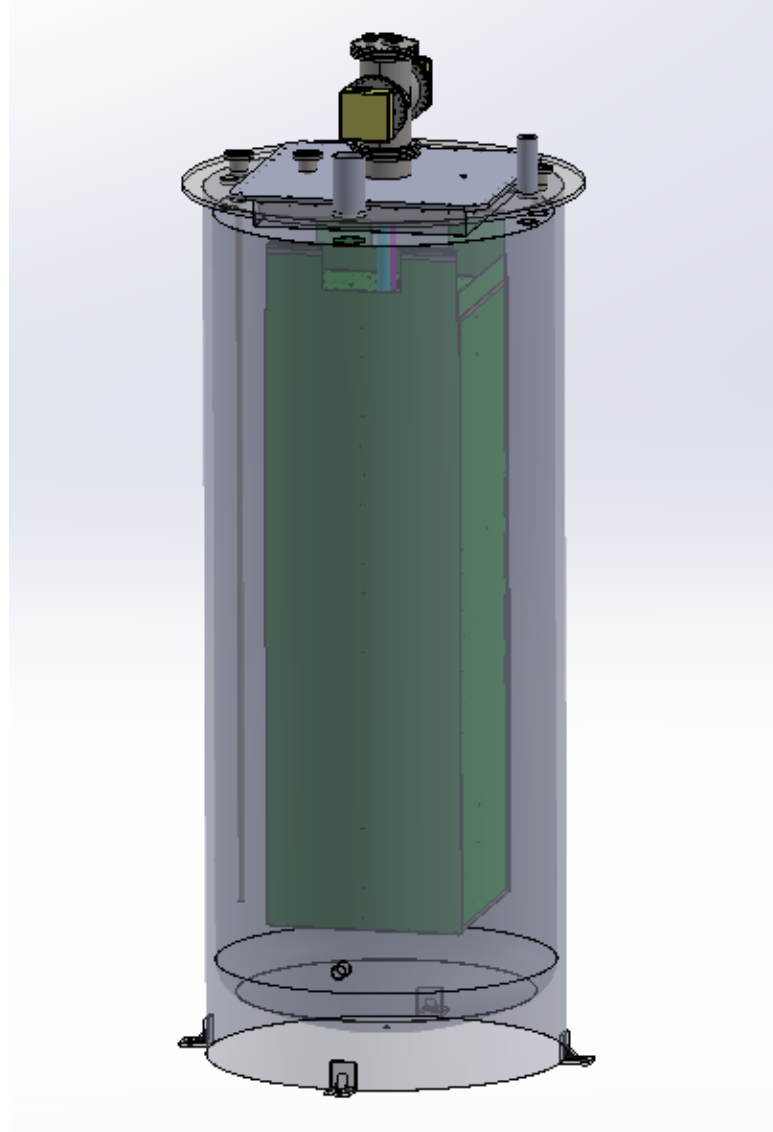
T. Rathmann





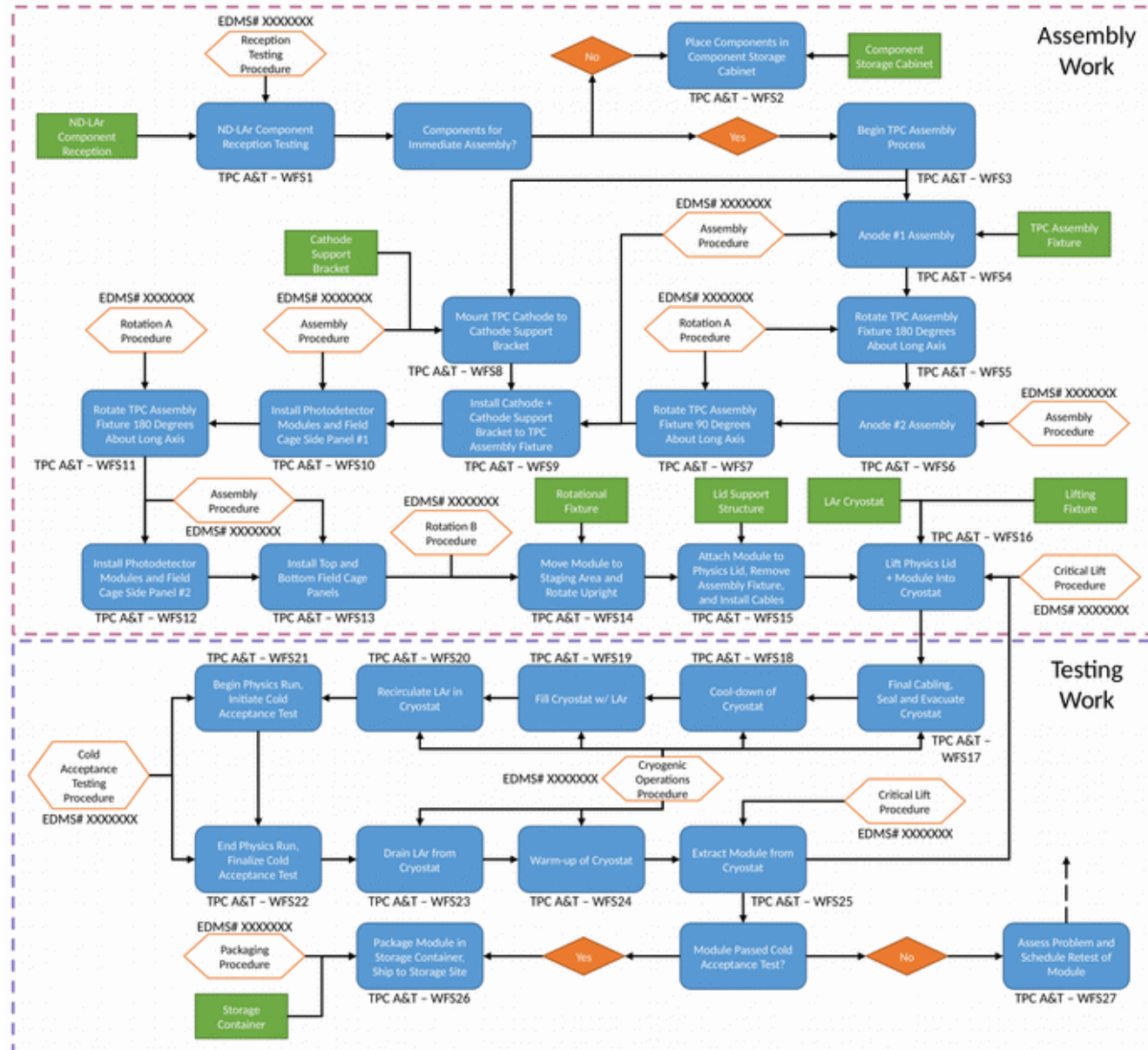
Updated Cryostat Drawing

**J. Jablonski,
Z. Rautio**



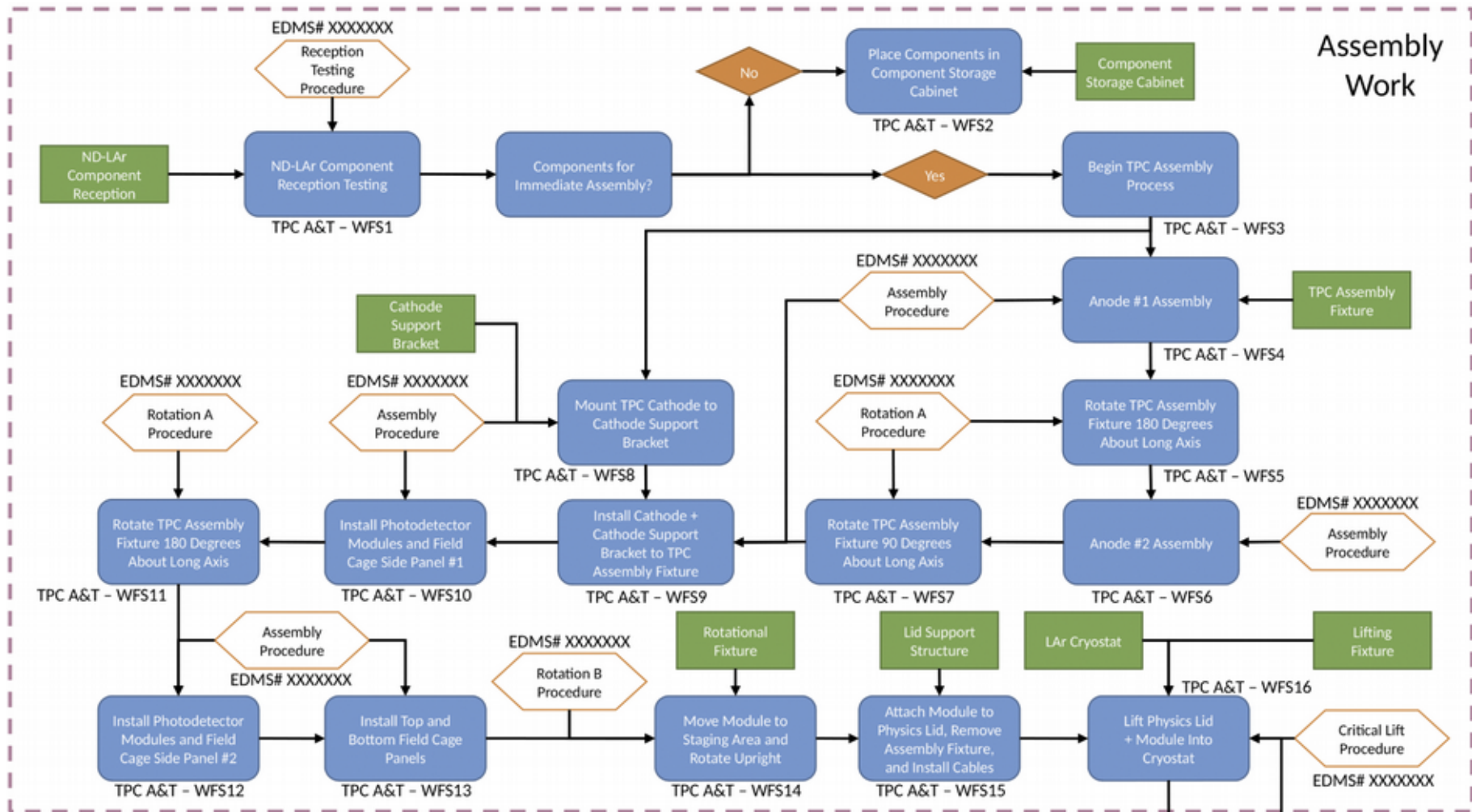
MATF Operations Flow Diagram

M. Mooney



MATF Operations Flow Diagram

M. Mooney



8

MATF Cryo Cycle Timeline

M. Mooney

Relative Time [Days]	Cryostat #1 Activities	Cryostat #2 Activities
0	Module #1 Insertion	
0.5	Evacuation	
1	Cool-down	
1.5		
2		
2.5		
3	Fill	
3.5	Recirculate	
4		
4.5		
5		Module #2 Insertion
5.5	Physics	Evacuation
6		Cool-down
6.5		
7		
7.5	End Physics	
8	Drain	Fill
8.5	Warm-up	Recirculate
9		
9.5		
10	Extract Module #1 & Module #3 Insertion	
10.5	Evacuation	Physics
11	Cool-down	
11.5		
12		
12.5		End Physics
13	Fill	Drain
13.5	Recirculate	Warm-up
14		
14.5		
15		Extract Module #2 & Module #4 Insertion
15.5	Physics	Evacuation
16		Cool-down
16.5		
17		
17.5	End Physics	
18	Drain	Fill
18.5	Warm-up	Recirculate
19		
19.5		
20	Extract Module #3 & Module #5 Insertion	
20.5	Evacuation	Physics
21	Cool-down	
21.5		
22		
22.5		End Physics
23	Fill	Drain
23.5	Recirculate ...	Warm-up ...

Critical Timescales:

5 Days /
Module Test
(1 Calendar Week)

10 Days / Single
Cryostat Cycle
(2 Calendar Weeks)

*This is before
considering possible
delays (have roughly
double time for testing)*

Improving Labor Estimates

A. Lambert

Example from I&I:

Production phase							
Component number / task time / effort fraction	Numbers/rate						
Number of ND LArTPC Modules per row assembly	5.00						
Number of row assemblies required for ND LArTPC	7.00						
Spare row assemblies	1.00						
Total number of row assemblies	8.00						
Total number of ND LArTPC Modules	35.00						
ND-LAr Module Receipt at Near Site Surface Building							
TPC-WFS1: Transport ND-LAr Modules to NS Surface Building Unpacking Area	Duration [Hours]	% ND-LAr Engineer	% ND-LAr Mech Tech	% ND-LAr Elec Tech	% I&I Tech/Rigger	% ND-LAr Physicist	% PostDoc/Student
Forklift Move of Module Crate - Critical Lift	1.00	100%	100%	0%	200%	0%	0%
Retrieve from Storage and Transport to Near Site Surface Building	2.00	0%	0%	0%	100%	0%	0%
Forklift Move of Module Crate - Critical Lift	1.00	100%	100%	0%	200%	0%	0%
TPC-WFS1 Total Hours	4.00	2.0	2.0	0.0	6.0	0.0	0.0
TPC-WFS2: ND-LAr Module Crate Opening & Perform Functional Verifications	Duration [Hours]	% ND-LAr Engineer	% ND-LAr Mech Tech	% ND-LAr Elec Tech	% I&I Tech/Rigger	% ND-LAr Physicist	% PostDoc/Student
Remote Crate Lid/Wall to Access ND-LAr Module	1.00	0%	100%	0%	0%	0%	200%
Stage Area for Functional Verification Test	3.00	0%	100%	0%	0%	0%	200%
Cable up ND-LAr Module in Crate to Portable EV Rig	2.00	0%	100%	100%	0%	100%	200%
Perform EV Tests and Document Results	6.00	0%	0%	100%	0%	100%	200%
TPC-WFS2 Total Hours	12.00	0.0	6.0	8.0	0.0	8.0	24.0
TPC-WFS3: ND-LAr Module Crate Unpacking for ND-LAr Module Extraction	Duration [Hours]	% ND-LAr Engineer	% ND-LAr Mech Tech	% ND-LAr Elec Tech	% I&I Tech/Rigger	% ND-LAr Physicist	% PostDoc/Student
Unpackage ND-LAr Module Crate	4.00	0%	100%	0%	0%	0%	200%
Prepare ND-LAr Module for Extraction from Crate	4.00	0%	100%	0%	0%	0%	200%
TPC-WFS3 Total Hours	8.00	0.0	8.0	0.0	0.0	0.0	16.0
Acceptance Hours per Module Row	120.00	10.00	80.00	40.00	30.00	40.00	200.00
Acceptance Hours Total	840.00	70.00	560.00	280.00	210.00	280.00	1,400.00
Duration in Weeks	21.00						
ND-LAr Module Integration at Near Site Surface Building							
TPC-WFS4: Extraction of ND-LAr Modules from Crate and Install to Rotation Fixture - Critical Lift	Duration [Hours]	% ND-LAr Engineer	% ND-LAr Mech Tech	% ND-LAr Elec Tech	% I&I Tech/Rigger	% ND-LAr Physicist	% PostDoc/Student
Install Rigging	0.25	100%	200%	0%	100%	0%	300%
Lift/Extract Module From Crate	0.50	100%	200%	0%	200%	0%	400%
Translate Module to Rotation Fixture	0.25	100%	200%	0%	200%	0%	400%
Lower/Install Module to Rotation Fixture	0.50	100%	200%	0%	200%	0%	400%
Remove Rigging	0.25	100%	200%	0%	100%	0%	400%
Stow Module Crate Using Forklift	0.25	100%	200%	0%	100%	0%	400%
Total WFS4 Hours	2.00	2.00	4.00	0.00	3.25	0.00	7.75

◆ M. Mooney currently drafting version for TPC A&T

BACKUP SLIDES

Testing Plan for DUNE ND-LAr Module Integration Facility

Michael Mooney, John Jablonski, Andrew Lambert

December 18, 2020

- ◆ Testing plan covers cryogenic testing at MIF:
 - Overview of MIF
 - Testing procedure
 - Performance metrics (criteria to determine pass/fail for module)
- ◆ Much overlap with PDR (for now) – will change over time as plans become more detailed
- ◆ Specific requirements (allowed range of values) for performance metrics to be determined later
 - Document suggests FSD will inform these requirements

Testing Plan for DUNE ND-LAr Module Integration Facility

Michael Mooney, John Jablonski, Andrew Lambert

December 18, 2020

A number of performance metrics will be checked for each ND-LAr during cryogenic testing at the MIF. These metrics include:

- number of dead channels in the pixel planes and light detectors;
- noise levels in the pixel plane and light detector channels;
- amount of cross-talk between the pixel planes and light detectors;
- magnitude of unexpected electric field distortions in the TPC volume;
- stability of electronics gain and other operational parameters; and
- stability of the cathode HV.

QA/QC Plan for DUNE ND-LAr Module Integration Facility

Michael Mooney, John Jablonski, Andrew Lambert

December 18, 2020

- ◆ QA/QC plan includes:
 - Overview of MIF (overlap with Testing Plan, but useful?)
 - Assembly procedure (referenced by QA plan)
 - QA plan
 - QC plan
- ◆ Rough QA plan: validate design of assembly/lifting fixtures at FSD test; also training of MIF personnel during FSD test
- ◆ Rough QC plan: MIF itself is QC of integrated TPC modules for ND-LAr; references Testing Plan for pass/fail criteria